Command-Line Tools Guide

Netscape Certificate Management System

Version 6.2

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About This Guide

The *Command-Line Tools Guide* describes various command-line tools or utilities that are bundled with Netscape Certificate Management System (CMS). It provides the information such as the command syntax, platform support, examples, and so on, required to use these tools.

This preface has the following sections:

- Who Should Read This Guide
- What You Should Know
- What's in This Guide
- Conventions Used in This Guide
- Documentation

Who Should Read This Guide

This guide is intended for experienced system administrators who are planning to deploy Certificate Management System. CMS agents should refer to *CMS Agent's Guide* for information on how to perform agent tasks, such as handling certificate requests and revoking certificates.

What You Should Know

This guide assumes that you

- Are familiar with the basic concepts of public-key cryptography and the Secure Sockets Layer (SSL) protocol.

- SSL cipher suites
- The purpose of and major steps in the SSL handshake

- Understand the concepts of intranet, extranet, and the Internet security and the role of digital certificates in a secure enterprise. These include the following topics:
    - Encryption and decryption
    - Public keys, private keys, and symmetric keys
    - Significance of key lengths
    - Digital signatures
    - Digital certificates, including various types of digital certificates
    - The role of digital certificates in a public-key infrastructure (PKI)
    - Certificate hierarchies

  If you are new to these concepts, we recommend that you read the security-related appendixes of the accompanying manual, *Managing Servers with Netscape Console*.

What’s in This Guide

This guide contains the following topics:

Chapter 1 “Command-Line Tools”	Provides an overview of the command-line tools provided with Certificate Management System, including the ones that are not covered in this documentation.
Chapter 2 “CMS Upgrade Utility”	Describes how to use the utility to upgrade from a previous release of Certificate Management System.
Chapter 3 “Password Cache Utility”	Describes how to use the tool for managing the single sign-on password cache.
Chapter 4 “AuditVerify”	Describes how to use the tool used to verify signed audit logs.

Chapter 5 “PIN Generator Tool”	Describes how to use the tool for generating unique PINs for your users and for populating their directory entries with PINs.
Chapter 6 “Extension Joiner Tool”	Describes how to use the tool for joining MIME-64 encoded formats of certificate extensions to create a single blob.
Chapter 7 “Backing Up and Restoring Data”	Describes how to use the tools for backing up, signing, verifying, and restoring data to a CMS instance.
Chapter 8 “ASCII to Binary Tool”	Describes how to use the tool for converting ASCII data to its binary equivalent.
Chapter 9 “Binary to ASCII Tool”	Describes how to use the tool for converting binary data to its ASCII equivalent.
Chapter 10 “Pretty Print Certificate Tool”	Describes how to use the tool for printing or viewing the contents of a certificate stored as ASCII base-64 encoded data in a human-readable form.
Chapter 11 “Pretty Print CRL Tool”	Describes how to use the tool for printing or viewing the contents of a CRL stored as ASCII base-64 encoded data in a human-readable form.

Conventions Used in This Guide

The following conventions are used in this guide:

`Monospaced font`	This typeface is used for any text that appears on the computer screen or text that you should type. It’s also used for filenames, functions, and examples. Example: `Server Root` is the directory where the CMS binaries are kept.
Italic	Italic type is used for emphasis, book titles, and glossary terms. Example: This control depends on the access permissions the *super administrator* has set up for you.
Boldface	Boldface type is used for various UI components such as captions and field names, and the terminology explained in the glossary.

	Example: **Rotation frequency.** From the drop-down list, select the interval at which the server should rotate the active error log file. The available choices are Hourly, Daily, Weekly, Monthly, and Yearly. The default selection is Monthly.
`Monospaced []`	Square brackets enclose commands that are optional. Example: `PrettyPrintCert <input_file> [<output_file>]` `<input_file>` specifies the path to the file that contains the base-64 encoded certificate. `<output_file>` specifies the path to the file to write the certificate. This argument is optional; if you don't specify an output file, the certificate information is written to the standard output.
`Monospaced <>`	Angle brackets enclose variables or placeholders. When following examples, replace the angle brackets and their text with text that applies to your situation. For example, when path names appear in angle brackets, substitute the path names used on your computer. Example: Using Netscape Communicator 4.7 or later, enter the URL for the Netscape Administration Server: `http://<hostname>:<port_number>`
`/`	A slash is used to separate directories in a path. Example: Except for the Security Module Database Tool, you can find all the other command-line utilities at this location: `<server_root>/bin/cert/tools`

Notes and Cautions:

NOTE A note alerts you to information that may be of interest to you.

CAUTION A caution signals a potential risk of losing data, damaging software or hardware, or otherwise disrupting system performance.

Documentation

All documentation is installed with the product and can be accessed from the help system. Further, the documentation can also be accessed from the installed product in the following directory:

`<server_root>/manual/en/`

The documentation set for CMS includes the following:

Managing Servers with Netscape Console

Provides background information on basic cryptography concepts and the role of Netscape Console.

CMS Administrator's Guide

Describes how to plan for, install, and administer CMS.

CMS Command-Line Tools Guide (this guide)

Provides detailed reference information on CMS tools.

CMS Customization Guide

Provides detailed reference information on customizing the HTML-based agent and end-entity interfaces.

CMS Agent's Guide

Provides detailed reference information on CMS agent interfaces. To access this information from the Agent Services pages, click any help button.

Chapter 1

Command-Line Tools

Netscape Certificate Management System (CMS) is bundled with various command-line utilities. This chapter summarizes these utilities and provides pointers to chapters that further explain them.

Table 1-1 summarizes the command-line utilities that are bundled with Certificate Management System.

Table 1-1 Summary of command-line utilities

Utility/Tool	Function
Batch/Shell Scripts located under <server_root>/bin/cert/tools/ (requires <server_root>/bin/cert/jre/bin/java): :	
`AtoB` (ASCII to Binary Tool)	Converts ASCII base-64 encoded data to binary base-64 encoded data. For details, see Chapter 8, "ASCII to Binary Tool."
`AuditVerify` (Signed Audit Verification Tool)	A command line utility utilized to verify signatures in signed audit log files. For details, see Chapter 4, "AuditVerify."
`BtoA` (Binary to ASCII Tool)	Converts binary base-64 encoded data to ASCII base-64 encoded data. For details, see Chapter 9, "Binary to ASCII Tool."
CMCEnroll (CMC Enrollment Utility)	A command line utility used to sign a certificate enrollment request with an agent's certificate. For details, see the CMC Enroll Utility in the Administrator's Guide.
CMCRevoke (CMC Revocation Utility)	A command line utility used to sign a revocation request with an agent's certificate. For details, see the CMC Revoke Utility in the Administrator's Guide.
CRMFPopClient (CRMF Pop Request Tool)	A command line utility used to generate CRMF requests with proof of possession (POP).

Table 1-1 Summary of command-line utilities *(Continued)*

Utility/Tool	**Function**
ExtJoiner (Extension Joiner Tool)	A command line utility utilized to join a sequence of extensions together so that the final output can be used in the configuration wizard for specifying extra extensions in default certificates (i. e. - CA certificate, SSL certificate). For details, see Chapter 6, "Extension Joiner Tool."
GenExtKeyUsage (Key Usage Extension Tool)	A command line utility utilized to generate a DER-encoded Extended Key Usage extension. The first parameter is the criticality of the extension, true or false. The OIDs to be included in the extension are passed as command-line arguments. The OIDs are described in RFC 2459. For example, the OID for code signing is 1.3.6.1.5.5.7.3.3.
GenIssuerAltNameExt (Issuer Alternative Name Extension Tool)	A command line utility utilized to generate an issuer alternative name extension in base-64 encoding. The encoding output can be used with the configuration wizard, using parameter pairs where the first parameter specifies the general type from among "DNSName", "EDIPartyName", "IPAddressName", "URIName", "RFC822Name", "OIDName", or "X500Name", and the second parameter specifies a general name for this type.
GenSubjectAltNameExt (Subject Alternative Name Extension Tool)	A command line utility utilized to generate a subject alternative name extension in base-64 encoding. The encoding output can be used with the configuration wizard, using parameter pairs where the first parameter specifies the general type from among "DNSName", "EDIPartyName", "IPAddressName", "URIName", "RFC822Name", "OIDName", or "X500Name", and the second parameter specifies a general name for this type.
`PasswordCache` (Password Cache Utility)	Manipulates the contents of the single sign-on password cache. For details, see Chapter 3, "Password Cache Utility."
PQGGen (PQG Generation Tool)	A command line utility utilized to generate the P, Q, and G values required by the DSA algorithm. See RFC 2459, section 7.3.3: DSA Signature Keys for more information.
`PrettyPrintCert` (Pretty Print Certificate Tool)	Prints the contents of a certificate stored as ASCII base-64 encoded data in a human-readable form. For details, see Chapter 10, "Pretty Print Certificate Tool."
`PrettyPrintCrl` (Pretty Print CRL Tool)	Prints the contents of a CRL stored as ASCII base-64 encoded data in a human-readable form. For details, see Chapter 11, "Pretty Print CRL Tool."
Executable tools located under <server_root>/bin/cert/tools:	

Table 1-1 Summary of command-line utilities *(Continued)*

Utility/Tool	Function
`bulkissuance` (Bulk Issuance Tool)	A command line utility utilized to send either a KEYGEN or CRMF enrollment request to the bulk issuance interface for the automatic creation of certificates.
`certutil` (Certificate and Key Database Tool)	View and manipulate the certificate database (`cert8.db`) and key database (`key3.db`) contents. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
`cmsutil` (Cryptographic Message Syntax tool)	A command line tool used to perform basic Cryptographic Message Syntax operations related to encrypting, decrypting, and signing messages using S/MIME. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
`crlutil` (Certificate Revocation List utility)	A command line tool used to manage CRLs within the certificate database.
`pk12util` (PKCS #12 utility)	A command line tool used to import and export keys and certificates between the cert/key databases and files in PKCS #12 format. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
`revoker (automation utility)`	A command line tool which may be conveniently utilized to automate user management scripts used to revoke certificates.
`setpin` (PIN Generator tool)	Generates PINs for end users for directory- and PIN-based authentication. For details, see Chapter 5, "PIN Generator Tool." This tool utilizes a configuration file called "setpin.conf".
`signtool` (Netscape Signing Tool)	Digitally signs any file, including log files. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
`signver` (Netscape Signature Verification Tool)	A command line tool used to create digitally-signed jar archives containing files and/or code. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
`ssltap` (SSL Debugging Tool)	Used to debug SSL applications. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
Batch/Shell Scripts located under <server_root>/bin/cert/upgrade/ (requires <server_root>/bin/cert/jre/bin/java):	

Table 1-1 Summary of command-line utilities *(Continued)*

Utility/Tool	Function
Upgrade Utility (Upgrade an old CMS version to CMS 6.2)	Upgrades from a CMS 4.2, CMS 4.2 (SP 2), 4.5, 6.0, 6.01, or 6.1 (SP 1) instance to a CMS 6.2 instance. For details, see Chapter 2, "CMS Upgrade Utility."
Batch/Shell Scripts located under <server_root>/cert-<instance> (requires <server_root>/install/perl):	

`cmsbackup`
`(Backup a CMS instance)`
	Copies all of the pertinent data and configuration files for a CMS instance, the local Administration Server, and local Netscape Directory Servers that the instance uses into a compressed archive. For details, see Chapter 7, "Backing Up and Restoring Data." This tool utilizes two Perl support scripts located in <server_root>/bin/cert/tools called "CMSBackup.pl" and "CMSCommon.pl".

`cmsrestore`
`(Restore a backed-up CMS instance)`
	Opens a named archive, extracts the data, and uses it to restore the configuration of a CMS instance. For details, see Chapter 7, "Backing Up and Restoring Data."This tool utilizes two Perl support scripts located in <server_root>/bin/cert/tools called "CMSCommon.pl" and "CMSRestore.pl".

Common Criteria Batch/Shell Scripts and executable tools located under <server_root>/bin/cert/tools:	
`cmssuid (execute setuid/setgid program tool)`	A command line utility existing ONLY on Solaris platform versions of the CMS server used to launch processes as setuid/setgid scripts. This program is intended for use with CMS when it must be set up as a Common Criteria Target of Evaluation. This tool utilizes a configuration file called "/etc/cmssuid.cfg", a sample of which is included in the <server_root>/bin/cert/tools directory.
`toecrle.sh (ld.config Bourne shell script)`	A Bourne shell script existing ONLY on Solaris platform versions of the CMS server used to configure the "/var/ld/ld.config" database. This script is intended for use with CMS when it must be set up as a Common Criteria Target of Evaluation.
`toperms.sh (permissions Bourne shell script)`	A Bourne shell script existing ONLY on Solaris platform versions of the CMS server used to set permissions on various files and directories. This script is intended for use with CMS when it must be set up as a Common Criteria Target of Evaluation.
Executable tools located under <server_root>/shared/bin:	
`modutil` (Security Module Database Tool)	Used for managing the PKCS #11 module information within `secmod.db` files or within hardware tokens. For details, check the `http://www.mozilla.org/projects/security/pki/nss/tools/`. site.
Third-party executable tools located under <server_root>/bin/cert/tools:	

Table 1-1 Summary of command-line utilities *(Continued)*

Utility/Tool	Function

`dumpasn1`
`(Display the contents of binary base-64 encoded data)`
	Dumps the contents of binary base-64-encoded data. Note that the tool is freeware that is packaged with Certificate Management System for your convenience. For more information about this tool, check this site:
	`http://www.cs.auckland.ac.nz/~pgut001/`
	
	This tool utilizes a configuration file called "dumpasn1.cfg". A statement regarding the licensing of this executable and configuration file is located in the <server_root>/bin/cert/tools directory in a file called "README".

Third-party support tools located under <server_root>:	

`bin/base/jre/bin/jre`
`(Client JVM runtime)`
	Java runtime executable for Netscape Console (utilizes the Client JVM).

`bin/cert/jre/bin/jre`
`(Server JVM runtime)`
	Java runtime executable for Certificate Management System (utilizes the Server JVM).

`bin/cert/tools/unzip`
`(Decompression utility)`
	Decompression utility executable. The third-party license for this utility is contained in the <server_root>/bin/cert/tools directory in a file called "infozip_license".

`bin/cert/tools/zip`
`(Compression utility)`
	Compression utility executable. The third-party license for this utility is contained in the <server_root>/bin/cert/tools directory in a file called "infozip_license".

`install/perl`
`(Perl scripting language)`
	`perl` scripting language executable.

The Certificate Database Tool (`certutil`), Netscape Signing Tool (`signtool`), Netscape Signature Verification Tool (signver), PKCS #12 Utility (pk12util), Cryptographic Message Syntax Tool (cmsutil), SSL Debugging Tool (`ssltap`), and Security Database Tool (`modutil`) are a part of Network Security Services (NSS) tools. The remaining tools are either CMS-specific tools or Third-party support tools.

- The `AtoB`, `BtoA`, `PrettyPrintCert`, `PrettyPrintCrl`, and `dumpasn1` tools are useful for converting back and forth between various encodings and formats you may encounter when dealing with keys and certificates.
- The Password Cache Utility can be used to manipulate the contents of an existing single sign-on password cache and to create a new cache.
- The PIN Generator tool is used to create PINs for directory authentication.

- The Certificate and Key Database Tool and Security Module Database Tool are useful for a variety of administrative tasks that involve manipulating certificate and key databases.
- The Netscape Signing Tool can be used to associate a digital signature with any file, including CMS log files.
- The SSL Debugging Tool is useful for testing and debugging purposes.

If you find any problems with NSS tools, you may obtain the source code and build instructions for the very latest version of these tools (and/or potentially a binary image for the newer tool) at the following URL:

`http://www.mozilla.org/projects/security/pki/nss/tools/index.html`

If you're familiar with older versions of NSS tools, notice that all Key Database Tool functions have now been incorporated into the single tool, Certificate Database Tool, and that several of the command-line options for many of the tools may have changed. Be sure to check back often to obtain the very latest version of the desired security tool, as this site is updated often.

Chapter 2

CMS Upgrade Utility

If you have a previous installation of Netscape Certificate Management System (Certificate Management System), you can use the CMS Upgrade utility for upgrading to Certificate Management System, version 6.2. The utility enables you to upgrade from the following releases of Certificate Management System (CMS) to the CMS 6.2 release:

- CMS 4.2
- CMS 4.2 (SP 1)
- CMS 4.2 (SP 1a)
- CMS 4.2 (SP 2)
- CMS 4.5
- CMS 6.0
- CMS 6.01
- CMS 6.1 (SP 1)

NOTE: Always perform the steps in the upgrade procedure for each and every instance to be migrated!

There are three phases to upgrading from a previous CMS instance. This chapter explains these phases in the following sections:

- "Before Upgrading," on page 20
- "Upgrading," on page 20
- "After Upgrading," on page 31

Before Upgrading

Before upgrading from a CMS 4.2, 4.2 (SP 1), 4.2 (SP 1a), 4.2 (SP 2), 4.5, 6.0, or 6.1 (SP 1) instance to a CMS 6.2 instance, you must complete the following tasks:

- Backing Up Your Previous CMS Instance

Backing Up Your Previous CMS Instance

You must backup your existing CMS 4.2, 4.2 (SP 1), 4.2 (SP 1a), 4.2 (SP 2), 4.5, 6.0, 6.01, or 6.1 (SP 1) instance before you can upgrade to CMS 6.2.

- For instructions to back up a CMS 4.2, 4.2 (SP 1), 4.2 (SP 1a), 4.2 (SP 2), or 4.5 instance, check the *CMS Command-Line Tools Guide* that was provided with the product; open the `<server_root>/manual/en/cert/tools/backup.htm` file. You can also find the CMS 4.5 documentation at this site: `http://enterprise.netscape.com/docs/cms/index.html`
- For instructions to back up a CMS 6.0, CMS 6.01, or CMS 6.1 (SP 1) instance, see Chapter 7, “Backing Up and Restoring Data.”

Upgrading

This section provides instructions for migrating to CMS 6.2 from earlier versions.

1. Install and Configure CMS 6.2

   The migration tools are available in the following directory: `<62_server_root>/bin/cert/upgrade`

2. Stop the CMS 6.2 instance. To stop the instance do the following:

   a. Go to the following directory: `<62_server_root>/cert-<instance>`

   b. Execute the following command: `stop-cert`

3. Copy the key (cert7.db, key3.db) into CMS 6.2's alias directory. To do this, follow these steps:

   a. Go to the following directory:

   `<old_server_root>`

b. What you do next depends on which version you are converting. Follow the steps below that apply to the version you are converting:

For migrating from CMS 4.2/CMS 4.2 (SP 1) or CMS 4.2 (SP 1a):

i. Remove the following file from the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-cert8.db`

ii. Copy the following filefrom the old server:
`<old_server_root>/cert-<instance>/config/cert7.db`
to the following location in the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-cert7.db`

iii. Copy the following file from the older server:
`<old_server_root>/cert-<instance>/config/key3.db`
to the following location in the new server:

`<62_server_root>/alias/cert-<instance>-<hostname>-key3.db`
(overwrite this file)

iv. Copy the following file from the older server:
`<old_server_root>/admin-serv/config/secmodule.db`
to the following location in the new server:
`<62_server_root>/alias/secmod.db`
(overwrite this file)

For migrating from CMS 4.2 (SP 2) or CMS 4.5:

i. Remove the following file from the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-cert8.db`

ii. Copy the following file from the older server:
`<old_server_root>/cert-<instance>/config/cert7.db`
to the following location in the new server:

`<62_server_root>/alias/cert-<instance>-<hostname>-cert7.db`

iii. Copy the following file from the older server:
`<old_server_root>/cert-<instance>/config/key3.db`
to the following location in the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-key3.db`
(overwrite this file)

iv. Copy the following file from the older server:
`<old_server_root>/admin-serv/config/secmod.db`
to the following location in the new server:
`<62_server_root>/alias/secmod.db` (overwrite this file)

For migrating from CMS 6.0 or CMS 6.01 or CMS 6.1 (SP 1):

i. Remove the following file from the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-cert8.db`

ii. Copy the following file from the older server:
`<old_server_root>/alias/cert-<instance>-<hostname>-cert7.db`
to the following location in the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-cert7.db`

iii. Copy the following file from the older server:
`<old_server_root>/alias/cert-<instance>-<hostname>-key3.db`
to the following location in the new server:
`<62_server_root>/alias/cert-<instance>-<hostname>-key3.db`
(overwrite this file)

iv. Copy the following file from the older server:
`<old_server_root>/alias/secmod.db`
to the following location in the new server:
`<62_server_root>/alias/secmod.db (overwrite this file)`

4. List the content of pwcache.p12 (CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)/ CMS 4.2 (SP 2), or CMS 4.5) or pwcache.db (CMS 6.0 / CMS 6.01/ CMS 6.1 (SP 1)) in the old instance.

Migrating from CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)/ CMS 4.2 (SP 2), or CMS 4.5:

a. Go to the following directory:
`<old_server_root>/cert-<instance>`

b. Execute the following command:

```
<old_server_root>/bin/cert/tools/PasswordCache <password>
list
For example:
```

```
<old_server_root>/bin/cert/tools/PasswordCache <password>
list
```

```
----- Password Cache -----
Internal LDAP Database : <password>
Internal Key Storage Token : <password>
```

Migrating from CMS 6.0 / CMS 6.01/ CMS 6.1 (SP 1):

a. Go to the following directory:
`<old_server_root>/cert-<instance>/config`

Execute the following command:

```
<old_server_root>/bin/cert/tools/PasswordCache <password> -d
<alias directory> -P <prefix> list
```

For example:

```
<old_server_root>/bin/cert/tools/PasswordCache <password> -d
<old_server_root>/alias -P cert-<instance>-<hostname>- list

cert/key prefix = cert-<instance>-<hostname>-
path = <old_server_root>/alias
about to read password cache
----- Password Cache Content -----
internal : <password>
Internal LDAP Database : <password>
```

5. Recreate the pwcache.db in CMS 6.2 instance. To do this:

a. Go to the following directory:
`<62_server_root>/cert-<instance>/config`

b. Remove pwcache.db (this is the original password cache file created during CMS 6.2 configuration)

c. Generate protection key.

To do this, execute the following command:
```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<alias directory> -P <prefix> -c <file> rekey
```

For example:
```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<62_server_root>/alias -P cert-<instance>-<hostname>- -c
pwcache.db rekey
```

The following will be output to the screen when the command is run:

```
cert/key prefix = cert-<instance>-<hostname>-

cert/key db path = <62_server_root>/alias

password cache file = pwcache.db

token name = internal

generating new key...

PWsdrCache: mToken = internal

PWsdrCache: SDR key generated

key generated successfully with key id =
OPHHNSQTY0RUGFJbcaco1g==

Save the VALUE portion of this key id in a local file,

and under variable "pwcKeyid" in CMS.cfg!!

If you have not already done so,

remove the old pwcache.db and use this local file to add
passwords.
```

d. Save the value portion of the key id into a local file such as key.txt

e. Save the value portion of the key id into the CMS.cfg file under the variable "pwcKeyid"

Execute the following command:
```
touch pwcache.db
```
(This will recreate an empty file)

f. Add password tags and their associated passwords (from step 4.) back to the cache (You may need to do this mutiple times). Do this by executing the following command:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<alias directory> -P <prefix> -c <file> -k <key file> add
<tag> <associated_tag_password>
```

For example:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<62_server_root>/alias -P cert-<instance>-<hostname>- -c
pwcache.db -k key.txt add "Internal LDAP Database"
<associated_tag_password>
```

The following output will appear on the screen:

```
cert/key prefix = cert-<instance>-<hostname>-

cert/key db path = <62_server_root>/alias

password cache file = pwcache.db

token name = internal

PWsdrCache: mToken = internal

adding Internal LDAP Database:<associated_tag_password>

PWsdrCache: in addEntry

about to read password cache

PWsdrCache: after readPWcache()

adding new tag: Internal LDAP Database

operation completed for pwcache.db
```

```
<62_server_root>/bin/cert/tools/PasswordCache <password>

-d <62_server_root>/alias

-P cert-<instance>-<hostname>-

-c pwcache.db

-k key.txt add "Internal Key Storage Token"
<associated_tag_password>
```

```
cert/key prefix = cert-<instance>-<hostname>-

cert/key db path = <62_server_root>/alias
```

```
password cache file = pwcache.db

token name = internal

PWsdrCache: mToken = internal

adding Internal Key Storage Token:<associated_tag_password>

PWsdrCache: in addEntry

about to read password cache

PWsdrCache: after readPWcache()

adding new tag: Internal Key Storage Token

operation completed for pwcache.db
```

g. Confirm everything is OK. Execute the following command:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<alias directory> -P <prefix> -c <file> list
```

For example:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<62_server_root>/alias -P cert-<instance>-<hostname>- -c
pwcache.db list
```

The following is the output for this command:

```
cert/key prefix = cert-<instance>-<hostname>-

cert/key db path = <62_server_root>/alias

password cache file = pwcache.db

token name = internal

PWsdrCache: mToken = internal

about to read password cache

----- Password Cache Content -----

Internal Key Storage Token : <associated_tag_password>

Internal LDAP Database : <associated_tag_password>
```

6. Update server.xml and CMS.cfg files for the the CMS 6.2 instance to use the appropriate nicknames in the values of any of the parameters. Look for nickname related parameters. To do this:

a. Go to the following directory:
`<62_server_root>/cert-<instance>/config`

b. What you do next depends on which version you are converting. Follow the steps below that apply to the version you are converting:

Migrating from CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)

NOTE: Replace the ca.ocsp_signing.cacertnickname with the ca.signing.cacertnickname (in CMS.cfg) since one does not exist in CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)

For example:

`servercertnickname (in server.xml)`

`ca.ocsp_signing.cacertnickname (in CMS.cfg)`

`ca.signing.cacertnickname (in CMS.cfg)`

Migrating from CMS 4.2 (SP 2), CMS 4.5, or CMS 6.0 / CMS 6.01/ CMS 6.1 (SP 1)

For example:

`servercertnickname (in server.xml)`

`ca.ocsp_signing.cacertnickname (in CMS.cfg)`

`ca.signing.cacertnickname (in CMS.cfg)`

7. Dump the old internal directory content into LDIF format. To do this:

a. Go to the following directory:
`<old_server_root>/slapd-<instance>-db`

b. Execute the db2ldif command to export the internal directory content.

Migrating from CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)/ CMS 4.2 (SP 2)/ CMS 4.5 use the following command:

```
db2ldif
```

Migrating from CMS 6.0 / CMS 6.01 / CMS 6.1 (SP 1) use the following command:

```
db2ldif -n userRoot
```

The LDIF file will be created in the following file:
`<old_server_root>/slapd-<instance>-db/ldif`

c. Go to the following directory:
`<old_server_root>/slapd-<instance>-db/ldif`

d. Rename the ldif file old.ldif

8. Dump the new internal directory content into LDIF format. To do this:

a. Go to the following directory:
`<62_server_root>/slapd-<instance>-db`

b. Execute the following db2ldif command to export the internal directory content:
`db2ldif -n userRoot`

   The LDIF file will be created in the following directory:
   `<62_server_root>/slapd-<instance>-db/ldif`

c. Go to the following directory:
`<62_server_root>/slapd-<instance>-db/ldif`

d. Rename the ldif file new.ldif

9. Adjust the LDIF content. To do this:

   Migrating from CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)/ CMS 4.2 (SP 2), or CMS 4.5:

   a. Go to the following directory:
   `<old_server_root>/slapd-<instance>-db/ldif`

   b. Delete the first 2 entries in old.ldif. They look like the following:

   ```
   Entry 1: <machine domain>
   Entry 2: cn=ldap://:<port>,<machine domain>
   ```

   For example:

   ```
   Entry 1: dc=cert,dc=netscape,dc=com
   Entry 2: cn=ldap://:38900,dc=cert,dc=netscape,dc=com
   ```

   c. `Replace the following entry with the one in new.ldif from step 8:`

   `cn=aclResources,o=netscapeCertificateServer`

   Migrating from CMS 6.0 / CMS 6.01 / CMS 6.1 (SP 1):

   a. Replace the following entry with the one in new.ldif from step 8:
   `cn=aclResources,o=netscapeCertificateServer`

10. Convert old.ldif into old.txt format by running the following:

   a. Unset environment variable (`JAVA_HOME=`)

   b. Set environment variable (`SERVER_ROOT=<old_server_root>`)

   c. Export environment variable (`export SERVER_ROOT`)

d. What you do next depends on which version you are converting. Follow the steps below that apply to the version you are converting:

Migrating from CMS 4.2 / CMS 4.2 (SP 1) / CMS 4.2 (SP 1a)

v. Go to the following directory:
`<62_server_root>/bin/cert/upgrade/42ToTxt`

vi. Execute the following command:

```
run.sh
<old_server_root>/slapd-<instance>-db/ldif/old.ldif >

<old_server_root>/slapd-<instance>-db/ldif/old.txt
```

Migrating from CMS 4.2 (SP 2)

i. Go to the following directory:
`<62_server_root>/bin/cert/upgrade/42SP2ToTxt`

ii. Execute the following command:

```
run.sh
<old_server_root>/slapd-<instance>-db/ldif/old.ldif >
<old_server_root>/slapd-<instance>-db/ldif/old.txt
```

Migrating from CMS 4.5

i. Go the following directory:
`<62_server_root>/bin/cert/upgrade/45ToTxt`

ii. Execute the following command:

```
run.sh
<old_server_root>/slapd-<instance>-db/ldif/old.ldif
><old_server_root>/slapd-<instance>-db/ldif/old.txt
```

Migrating from CMS 6.0 / CMS 6.01 / CMS 6.1 (SP 1)

i. Go to the following directory:

`<62_server_root>/bin/cert/upgrade/60ToTxt`

ii. Execute the following command:

```
run.sh
<old_server_root>/slapd-<instance>-db/ldif/old.ldif >

<old_server_root>/slapd-<instance>-db/ldif/old.txt
```

11. Move old.txt into CMS 6.2’s ldif directory. To do this:

   a. Go to the following directory:

      `<old_server_root>/slapd-<instance>-db/ldif`

   b. Move `<old_server_root>/slapd-<instance>-db/ldif/old.txt` into `<62_server_root>/slapd-<instance>-db/ldif`

12. Convert `old.txt` into `old.ldif` (6.2 format) by running:

   a. Unset environment variable (`JAVA_HOME=`)

   b. Set environment variable (`SERVER_ROOT=<62_server_root>, OS_NAME=<platform>`)

   c. Export environment variable (`export SERVER_ROOT, OS_NAME`)

   d. Go to the following directory:

      `<62_server_root>/bin/cert/upgrade/TxtTo61`

   e. Execute the following command:

      ```
      run.sh <62_server_root>/slapd-<instance>-db/ldif/old.txt >

      <62_server_root>/slapd-<instance>-db/ldif/old.ldif
      ```

13. Stop internal directory instance, import old LDIF file into new instance. To do this:

   a. Go to the following directory:

      `<62_server_root>/slapd-<instance>-db`

   b. Execute the following command:

      `stop-slapd`

   c. Execute the following command:

      ```
      ldif2db -n userRoot -i
      <62_server_root>/slapd-<instance>-db/ldif/old.ldif
      ```

   d. Execute the following command:

      `start-slapd`

14. Start CMS 6.2

   a. Go to the following directory:

      `<62_server_root>/cert-<instance>`

   b. Execute the following command:

      `start-cert`

After Upgrading

After upgrading to CMS 6.2, access the End-Entity Services and the Agent Services interfaces of the new CMS 6.2 instance to ensure that everything is working properly.

You must also log in to the CMS Console and verify that you can manage the server via the console.

The port numbers for all these interfaces can be found in this file:

```
<server_root>/config/server.xml
```

Chapter 3

Password Cache Utility

During the installation of Netscape Certificate Management System (CMS), the installation daemon stores all the passwords required by the server for starting up—such as the bind passwords used by Certificate Management System to access and update the internal LDAP database and the LDAP directory used for authentication or publishing—in a password cache. The cache is maintained in a file encrypted using a symmetric key generated by the cryptographic module wherein the key resides, and encrypted by the single sign-on password (internal cryptographic module password) you specify during installation.

The command-line utility named `PasswordCache` enables you to manipulate the contents of the password cache. You will be required to manipulate the password cache for various reasons. For example, assume you've configured the Certificate Manager to publish certificates and CRLs to an LDAP directory and have configured it to bind to the directory with Directory Manager's DN and password. If the directory administrator changes the Directory Manager's password, the Certificate Manager will fail to bind to the directory during startup. You can resolve this problem by modifying the corresponding bind password in the cache using the `PasswordCache` utility.

This chapter has the following sections:

- "Location," on page 33
- "Syntax," on page 34
- "Usage," on page 35

Location

The `PasswordCache` utility is located with the rest of the command-line tools in this directory: `<server_root>/bin/cert/tools`

Syntax

To run the utility, execute the following command from the `<server_root>/cert-<instance_id>/config` directory (must be run from this directory unless the "-c" option is used):

```
PasswordCache <sso_password> -d <certificate/key db directory> [-h
<token name>]
-P <certificate/key db prefix> [-c <pwcache db directory>] [-k <file
containing base-64 encoded key ID>] <command>
```

`<sso_password>` specifies the current single sign-on password.

`<certificate/key db directory>` specifies the path to the certificate database (`cert8.db`) and key database (`key3.db`) files. The default path is `<server_root>/alias`.

`<certificate/key db prefix>` specifies the prefix for the certificate database (`cert8.db`) and key database (`key3.db`) files. The default prefix is in the `cert-<instance_id>-<hostname>-` format.

`<token name>` refers to the label given to the attached hardware token (only relevent when the keys resident on a hardware token). The user may be prompted to enter the hardware token's password for access to the hardware token.

`<pwcache db directory>` specifies the path to the pwcache.db file. The default path is the present directory.

`<file containing base-64 encoded key ID>` specifies the file containing the ID to the protection key generated from a previous "rekey" command.

`<command>` can be any of the following:

`list` lists the contents of the password cache.

`rekey` generates a protection key and presents the base-64 encoded key ID on the screen. The administrator should store the blob to a local file (e.g., `keyID.txt`) and replace the value of the "pwcKeyid" in the `CMS.cfg` file.

`add <password_name> <password>`

`change <password_name> <password>`

`delete <password_name>`

`<password_name>` specifies the string (describing the password usage) you want to add to, or modify or delete from the cache; it is equivalent to the value assigned to the `bindPWPrompt` or `tokenname` parameter in the CMS configuration file. It is essential that the `<password_name>` coincide with the names known by Certificate Management System: for example, the internal cryptographic module is known as *internal*, the internal LDAP bind password is known as *Internal LDAP Database*, and the LDAP publishing bind password for the Certificate Manager is known as *CA LDAP Publishing*.

`<password>` specifies the new password.

Usage

You can use the `PasswordCache` utility for the following:

- Listing the Contents of the Password Cache
- Generating a new Protection Key for the Password Cache-
- Adding a New Entry to the Password Cache
- Changing the Password of an Entry in the Password Cache
- Deleting an Entry From the Password Cache

The sections that follow explain how you can accomplish the above mentioned tasks.

NOTE The server queries the password cache only during start up, and hence recognizes the changes you've made to the cache only if you restart the server from the command line. If you left any of the passwords blank, the server will prompt you to enter that during startup and from then on stores it in the password cache.

Listing the Contents of the Password Cache

To list or view the contents of the password cache:

1. Open a command window.
2. Go to this directory: `<server_root>/cert-<instance_id>/config`
3. At the prompt, enter the command below, substituting the variables with appropriate values:

```
PasswordCache <sso_password> -d <certificate/key db directory> -P
<certificate/key db prefix> list
```

For example, assume your single sign-on password is `mySsoPwd`, the CMS instance name is `demoCA`, and the host name is `cmshost`. The command would look like this:

```
PasswordCache mySsoPwd -d /usr/netscape/servers/alias
-P cert-demoCA-cmshost- list
```

Generating a new Protection Key for the Password Cache

To generate a new protection key for the password cache:

1. Execute the following command:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<alias directory> -P <prefix> -c <file> rekey
```

For example:

```
<62_server_root>/bin/cert/tools/PasswordCache <password> -d
<62_server_root>/alias -P cert-<instance>-<hostname>- -c
pwcache.db rekey
```

The following will be output to the screen when the command is run:

```
cert/key prefix = cert-<instance>-<hostname>-

cert/key db path = <62_server_root>/alias

password cache file = pwcache.db

token name = internal

generating new key...

PWsdrCache: mToken = internal

PWsdrCache: SDR key generated

key generated successfully with key id = OPHHNSQTY0RUGFJbcaco1g==

Save the VALUE portion of this key id in a local file,

and under variable "pwcKeyid" in CMS.cfg!!

If you have not already done so,

remove the old pwcache.db and use this local file to add
passwords.
```

2. Save the value portion of the key id into a local file such as key.txt
3. Save the value portion of the key id into the CMS.cfg file under the variable "pwcKeyid"

Adding a New Entry to the Password Cache

To add a new entry to the cache:

1. Open a command window.
2. Go to this directory: `<server_root>/cert-<instance_id>/config`
3. At the prompt, enter the command below, substituting the variables with appropriate values:

   ```
   PasswordCache <sso_password> -d <certificate/key db directory>
   -P <certificate/key db prefix> -k keyID.txt add <password_name>
   <password>
   ```

   For example, assume your single sign-on password is `mySsoPwd`, the CMS instance name is `demoCA`, the host name is `cmshost`, the string describing the password usage is `Bind Password for LDAP Publishing Directory`, and the password is `myLdapPubPwd`. The command would look like this:

   ```
   PasswordCache mySsoPwd -d /usr/netscape/servers/alias
   -P cert-demoCA-cmshost- -k keyID.txt add “CA LDAP Publishing”
   myLdapPubPwd
   ```

   If the password name string includes spaces, be sure to enclose the string in double quotes as indicated in the above example.

Changing the Password of an Entry in the Password Cache

To change the password associated with an entry in the password cache:

1. Open a command window.
2. Go to this directory: `<server_root>/cert-<instance_id>/config`
3. At the prompt, enter the command below, substituting the variables with appropriate values:

```
PasswordCache <sso_password> -d <certificate/key db directory>
-P <certificate/key db prefix> -k keyID.txt change
<password_name> <password>
```

For example, assume your single sign-on password is `mySsoPwd`, the CMS instance name is `demoCA`, the host name is `cmshost`, the string describing the password usage is `Bind Password for LDAP Publishing Directory`, and the new password is `myNewLdapPubPwd`. The command would look like this:

```
PasswordCache mySsoPwd -d /usr/netscape/servers/alias
-P cert-demoCA-cmshost- -k keyID.txt change “CA LDAP Publishing”
myNewLdapPubPwd
```

If the password name string includes spaces, be sure to enclose the string in double quotes as indicated in the above example.

Deleting an Entry From the Password Cache

To delete an entry from the cache:

1. Open a command window.
2. Go to this directory: `<server_root>/cert-<instance_id>/config`
3. At the prompt, enter the command below, substituting the variables with appropriate values:

```
PasswordCache <sso_password> -d <certificate/key db directory>
-P <certificate/key db prefix> delete <password_name>
```

For example, assume your single sign-on password is `mySsoPwd`, the CMS instance name is `demoCA`, the host name is `cmshost`, the string describing the password usage is `Bind Password for LDAP Publishing Directory`. The command would look like this:

```
PasswordCache mySsoPwd -d /usr/netscape/servers/alias
-P cert-demoCA-cmshost- delete “CA LDAP Publishing”
```

If the password name string includes spaces, be sure to enclose the string in double quotes as indicated in the above example.

Chapter 4

AuditVerify

About the AuditVerify Tool

The AuditVerify tool is used to verify that signed audit logs were signed with the signed audit private signing key, and that the signed audit log has not been compromised.

Auditors can verify the authenticity of signed audit logs using the AuditVerify tool. This tool uses the public key of the signed audit log signing certificate to verify the digital signatures embedded in a signed audit log. The tool returns output indicating either that the signed audit log was successfully verified or that the signed audit log was not successfully verified. An unsuccessful verification warns the auditor that the signature failed to verify, indicating the log file may have been tampered with (compromised).

Setting Up the Auditor’s Database

The AuditVerify tool needs access to a set of security databases containing the signed audit log signing certificate and its chain of issuing certificates. One of the CA certificates in the issuance chain must be marked as trusted in the database.

The auditor should import the audit signing certificate into his/her own certificate and key databases before running the tool. The auditor should not use the same security databases as the CMS instance that generated the signed audit log files.

If the auditor does not have a readily accessible certificate and key database, the auditor will have to create a set of certificate and key databases and import the signed audit log signing certificate chain.

To create the security databases and import the certificate chain (Note: if the auditor has a readily accessible certificate and key database, steps 1 and 2 should be skipped):

1. As an auditor, create the security database directory in your file system. For example:

   ```
   mkdir dbdir
   ```

2. Use the `certutil` tool to create an empty set of certificate databases in the directory you just created. For example:

   ```
   certutil -d <dbdir> -N
   ```

3. Import the CA certificate and log signing certificate into the databases, marking the CA certificate as trusted. The certificates can be obtained from the CA in ASCII format.

   For example:

   If the CA's certificate is in a file called `cacert`, and the log signing certificate is in a file called `logsigncert`, the commands would be:

   ```
   certutil -d dbdir -A -n "CA Certificate" -t "CT,CT,CT" -a -i
   cacert
   ```

   ```
   certutil -d dbdir -A -n "Log Signing Certificate” -a -i
   logsigncert
   ```

Audit Verify Tool Syntax

The AuditVerify tool has the following syntax:

```
AuditVerify -d <dbdir> -n <signing_certificate_nickname> -a
<log_list_file> -P <cert/key_db_prefix> [-v]
```

where:

`dbdir`	The directory containing the security databases where you have imported the audit log signing certificate.
`signing_certificate_nickname`	The nickname of the certificate used to sign the log files. The nickname will be whatever you used when you imported the log signing certificate into that database.

`log_list_file`	A text file you create containing a comma separated list (in chronological order) of the signed audit logs you are verifying (e.g., the content of the log_list_file would look like the following: `/user/server/cmsRoot/cert-ca/logs/signedAudit/ca_cert-ca_audit,/user/server/cmsRoot/cert-ca/logs/signedAudit/ca_cert-ca_audit.20030227102711,/user/server/cmsRoot/cert-ca/logs/signedAudit/ca_cert-ca_audit.20030226094015`)
`cert/key_db_prefix`	The prefix to prepend to the certificate and key database filenames. In most cases, since the auditor is using his own personal certificate and key databases, empty quotation marks (““) should be specified for this argument, since no prefix was prepended to the security database files you created.
`-v`	Specifies verbose output. This argument is optional.

Return Values

When you use the AuditVerify Tool, you will receive one of the following return values:

0	Indicates that the signed audit log has been successfully verified.
1	Indicates that the tool did not successfully run to completion.
2	Indicates that one or more invalid signatures were found when running the tool on the specified file. This means that one or more of the logs that you were verifying failed to verify.

Using the Audit Verify Tool

Once you have an appropriately-configured database directory, you can use the AuditVerify tool by following these steps:

1. Create a text file containing a comma-separated list of the files you want to verify. The name of this file will be used in the AuditVerify command to identify this file. In this example this file is called `logListFile`.

   For example, this file might contain the following contents:

   ```
   auditlog.1213, auditlog.1214, auditlog.1215
   ```

2. Got to the following directory:

   ```
   <server_root>/bin/cert/tools
   ```

3. Issue the AuditVerify command. For example:

   ```
   AuditVerify -d  /user/home/smith/.netscape -n auditsigningcert -a
   /etc/audit/logListFile -P "" -v
   ```

Chapter 5

PIN Generator Tool

For Netscape Certificate Management System (CMS) to use the authentication plug-in module named `UidPwdPinDirAuth` your authentication directory must contain unique PINs for each end entity to whom you intend to issue a certificate. To aid you in generating PINs for end-entity entries in a directory, Certificate Management System provides a command-line tool called the *PIN Generator*. This tool allows you to generate unique PINs for entries in an LDAP-compliant user directory. The tool stores these PINs (as hashed values) in the same directory against the corresponding user entries, and it copies the PINs to a text file, from which you can deliver the PINs to end entities by an appropriate, secure means.

This chapter explains how to use the PIN Generator. The chapter has the following sections:

- "Locating the PIN Generator Tool," on page 43
- "The setpin Command," on page 44
- "How the Tool Works," on page 49

Locating the PIN Generator Tool

You can find the PIN Generator at this location:

```
<server_root>/bin/cert/tools/setpin.exe
```

The setpin Command

You run the PIN Generator by entering the `setpin` command and its arguments in a command shell and monitoring the output in the shell window. This section gives the syntax for the `setpin` command and its arguments. For instructions on generating PINs and storing them in your authentication directory, see section "Setting Up Pin Based Enrollment" in Chapter 9 "Authentication" of *CMS Administrator's Guide.*

Command-Line Syntax

To set up directory for pin usage, modify setpin.conf, then run:

```
./setpin optfile=/bin/cert/tools/setpin.conf
```

Usage: `./setpin option=value ... option=value`

Table 5-1

host	LDAP host [required]
port	LDAP port (default 389)
binddn	DN to bind to directory as [required]
bindpw	Password associated with above DN
filter	Ldap search filter e.g. filter=(uid=*) [required]
basedn	Base DN used for LDAP search
length	Length of generated pins (default 6)
minlength	Minimum length of generated pins (not to be used with 'length')
maxlength	Maximum length of generated pins (not to be used with 'length')
gen	Permitted chars for pin. Type 'setpin gen' for more info
case	Restrict case of pins 'case=upperonly'
objectclass	Objectclass of LDAP entry to operate on (default pinPerson)
attribute	Which LDAP attribute to write to (default pin)
hash	Hash algorithm used to store pin: 'none', 'md5' or 'sha1' (default)
saltattribute	Which attribute to use for salt (default: dn)
input	File to use for restricting DN's, or providing your own pins

Table 5-1

output	Redirect stdout to a file
write	Turn on writing to directory (otherwise, pins will not get written)
clobber	Overwrite old pins in the directory
testpingen	Test pin generation mode. testpingen=count
debug	Turn on debugging, or use debug=attrs for even more
optfile	Read in options (one per line) from specified file
setup	Switch to setup mode
pinmanager	Pin Manager user to create in setup mode
pinmanagerpwd	password of pin manager user in setup mode
schemachange	make schema changes in setup mode

A description for each argument follows:

- `[host=<host_name> [port=<port_number>]]`

  `<host_name>` specifies the LDAP directory to connect to. This argument is required.

  `<port_number>` specifies the TCP/IP port to bind to; the default port number is the default LDAP port, 389.

- `["binddn=<user_id>"   bindpw=<bind_password>]`

  `<user_id>` specifies the user ID that has read and write permission to the LDAP directory; the PIN Generator binds to the directory as this user. This argument is required.

  `<bind_password>` specifies the password for the user ID that has read and write access to the LDAP directory. If the bind password is not given at the command line, the tool prompts for it.

- `["filter=<LDAP_search_filter>" [basedn=<LDAP_base_DN>]]`

  `<LDAP_search_filter>` Use this argument to filter those DNs in the directory for which the tool should generate PINs. For information on how to specify filters, see the information available at this URL: `http://developer.netscape.com/docs/manuals/dirsdk/capi/search.htm`. This argument is required.

`<LDAP_base_DN>` specifies the base DN to be utilized by the LDAP search filter. If this argument is not specified, the filter will begin searching from the root.

- `[length=<PIN_length> | minlength=<minimum_PIN_length> maxlength=<maximum_PIN_length>]`

  Use this argument to specify the exact number or a range of characters that a PIN must contain. The PINs can be either a fixed length or generated to be between two values (x,y) inclusive (x,y>0).

  `<PIN_length>` specifies the exact length for the PINs. For example, if you want PIN length to be eight characters, enter `8`. PIN length must be an integer greater than zero.

  `<minimum_PIN_length>` specifies the minimum length for the PINs. For example, if you want PIN length to be at least six characters, enter `6`.

  `<maximum_PIN_length>` specifies the maximum length for the PINs. For example, if you want PIN length to be nine characters at the most, enter `9`.

- `[gen=RNG-alpha | RNG-alphanum | RNG-printableascii]`

  Use this argument to specify the type of characters for PINs. The characters in the password can be constructed out of alphabetic characters (`RNG-alpha`), alphanumeric characters (`RNG-alphanum`), or any printable ASCII characters (`printableascii`).

- `[case=upperonly]`

  Use this argument with the `gen` parameter. If you do, the case for all alphabetic characters is fixed to uppercase only; otherwise, the case is mixed. Restricting alphabetic characters to uppercase reduces the overall combinations for the password space significantly.

- `[objectclass=<objectclass_to_add>]`

  Use this argument to specify the object class, if any, the tool should add to the authentication directory. By default it is `pinPerson`.

- `[attribute=<attribute_name_for_pins>]`

  Use this argument to specify the authentication directory attribute to which PINs should be published. If you don't specify an attribute, it defaults to `pin`, the new attribute added to the authentication-directory schema.

- `[hash=sha1 | md5 | none]`

Use this argument to specify the message digest algorithm the tool should use to hash the PINs before storing them in the authentication directory. If you want to store PINs as SHA-1 or MD5 hashed values in the directory, be sure to specify an output file for storing PINs in plain text. You will need the PINs in plain text for delivering them to end entities.

`sha1` produces a 160-bit message digest. This option is used by default.
`md5` produces a 128-bit message digest.
`none` does not hash the PINs.

- `[saltattribute=<LDAP_attribute_to_use_for_salt_creation>]`

  Use this argument to specify the LDAP attribute the tool should use for salt creation. If you specify an attribute, the tool integrates the corresponding value of the attribute with each PIN, and hashes the resulting string with the hash routine specified in the hash argument.

  If you don't specify this argument, the DN of the user is used. For details, see "How PINs Are Stored in the Directory" on page 54.

- `[input=<file_name>]`

  Use this argument to specify the name of the file that contains the list of DNs to process. Using this argument is optional. If you do, the tool compares the filtered DNs to the ones specified by the input file and generates PINs for only those DNs that are also in the file.

- `[output=<file_name>]`

  Use this argument to specify the absolute path to the file to which the tool should write the PINs as it generates them; this is the file to which the tool will capture the output.

  If you don't specify a filename, the tool will write the output to the standard output. In any case, all the error messages will be directed to the standard error.

- `[write]`

  Use this argument to specify whether the tool should write PINs to the directory. If specified, the tool writes PINs (as it generates) to the directory. Otherwise, the tool does not make any changes to the directory.

  For example, if you want to check PINs—that the PINs are being given to the correct users and that they are conforming to the length and character-set restrictions—before updating the directory, do not specify this option. You can check the PINs before updating the directory by looking at the output file; for details, see "Output File" on page 53.

- `[clobber]`

  Use this argument to specify whether the tool should overwrite preexisting PINs, if any, associated with a DN (user). If specified, the tool overwrites the existing PINs with the one it generates. Otherwise, it leaves the existing PINs as they are.

- `[testpingen=<count>]`

  Use this argument to test the pin-generation mode.

  `<count>` specifies the total number (in decimal) of PINs to be generated for testing purposes.

- `[debug]`

  Use this argument to specify whether the tool should write debugging information (to the standard error). If `debug=attrs` is specified, the tool writes much more information about each entry in the directory.

- `[optfile]`

  Use this argument to specify that the tool should read in options (one per line) from specified file; this option enables you to put all the arguments in a file, instead of typing them on the command line.

- `[setup pinmanager=<pinmanager_user>`
  `pinmanagerpwd=<pinmanager_password>]`

  When placed in the ’setup’ mode, this executable allows schema modifications to be performed to add things to the directory schema.

  `<pinmanager_userd>` used in conjunction with setup to specify the pin manager user that has permission to remove the PIN for the basedn specified.

  `<pinmanager_password>` specifies the password for the pin manager user.

- `[setup schemachange=<schema_change>"]`

  When placed in the ’setup’ mode, this executable allows schema modifications to be performed to add things to the directory schema.

  `<schema_change>` used in conjunction with setup to specify a schema change on the ’pin’ attribute as specified by the ’attribute’ argument (default ’pin’), and/or the ’pinPerson’ objectclass as specified by the ’objectclass argument (default: pinperson).

Example

The following command generates PINs for all entries that have the CN attribute (in their distinguished name) defined in an LDAP directory named laiking that is listening at port 19000. The PIN Generator binds to the directory as user DirectoryManager and starts searching the directory from the node dn=o=example.com in the directory tree. The tool overwrites the existing PINs, if any, with the new ones.

```
setpin host=lailing port=19000 "binddn=CN=directory manager"
bindpw=password "filter=(cn=*)" basedn=o=example.com clobber write
```

How the Tool Works

The Pin Generator allows you to generate PINs for user entries in an LDAP-compliant directory and update the directory with these PINs. To run the setpin command, you need at a minimum to specify the following:

- The host name (host) and port number (port) of the LDAP server
- The bind DN (binddn) and password (bindpw)
- An LDAP filter (filter) for filtering out the user entries that require PINs

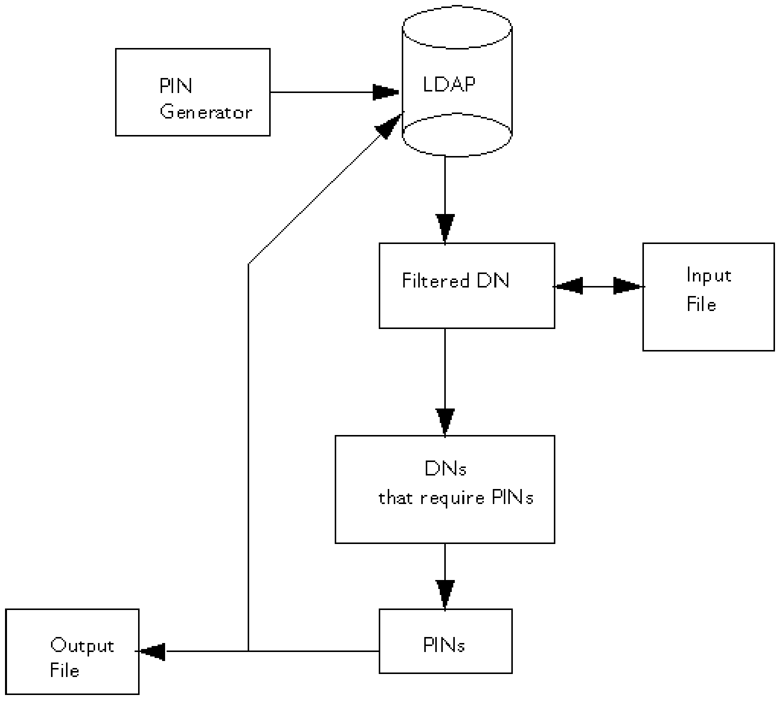
For example:

```
setpin host=laiking port=19000 "binddn=CN=Directory Manager"
bindpw=netscape "filter=(ou=employees)" basedn=o=example.com
```

This command, if run, will query the directory for all the entries that match the filter criteria, which in this case is all users belonging to an organizational unit (ou) called employees. For each entry matching the filter, information is printed out to standard error. Additionally, to the standard output or the file named in output; see “Output File” on page 53.

You can also provide the tool with an input argument using the input option. The argument must be in the form of an ASCII file of pre-prepared DNs and PINs (see Figure 5-1). Note that the input file is not a substitute for the LDAP directory entries; the filter attribute must still be provided. If an input file is provided, the tool updates only those filtered attributes that match the ones in the input file. For more information about the input file, see “Input File” on page 51.

Figure 5-1 Using an input and output file for the PIN-generation process



Examples of output follow:

```
Processing: cn=QA Managers,ou=employees,o=example.com

 Adding new pin/password

dn:cn=QA Managers,ou=employees,o=example.com
pin:lDWynV
status:notwritten


Processing: cn=PD Managers,ou=employees,o=example.com

 Adding new pin/password

dn:cn=PD Managers,ou=employees,o=example.com
pin:G69uV7
status:notwritten
```

Because the PIN Generator makes a lot of changes to your directory, it is important that you specify the correct filter; otherwise, you may change the wrong entries. As a safeguard, a `write` option is provided that you use to enable writing to the directory after you verify the output; the tool doesn't make any changes to the directory until you specify the `write` option on the command line.

The output also contains the status of each entry in the directory. It can be one of the values specified in Table 5-2.

Table 5-2 PIN Generator status

Exit code	Description
`notwritten`	Specifies that the PINs were not written to the directory, because the `write` option was not specified on the command line.
`writefailed`	Specifies that the tool made an attempt to modify the directory, but the write operation was unsuccessful.
`added`	Specifies that the tool added the new PIN to directory successfully.
`replaced`	Specifies that the tool replaced an old PIN with a new one (the `clobber` option was specified).
`notreplaced`	Specifies that the tool did not replace the old PIN with a new one (the `clobber` option was not specified).

If a PIN already exists for a user, it will by default not be changed if you run the `setpin` command a second time. This is so that you can generate PINs for new users without overwriting PINs for users who have previously been notified of their PINs. If you want to overwrite a PIN, you should use the `clobber` option.

Once you are sure that the filter is matching the right users, you should run the `setpin` command again with the `write` option, and with `output` set to the name of the file to capture the unhoused PINs. This output file is in the same format as the input file. For details about the output file, see “Output File” on page 53.

Input File

The PIN Generator can receive a list of DNs to modify in a text file specified by the `input=<file_name>` argument. If you specify an input file, the tool compares the DNs it filtered from the LDAP directory with the ones in the input file, and updates only those DNs that matched the ones in the input file.

The purpose of the input file is multi fold. It enables you to provide the Pin Generator with an exact list of DNs to modify. Via the input file, you can also provide the PIN Generator with PINs (in *plain text* format) for all DNs or for specific DNs.

The following examples explain why you might want to use the input file:

- Assume that you have set PINs for all entries in the user directory. Two new users joined your organization and you updated the directory with new users' information. For the new users to get certificates, the directory must contain PINs. And you want to set PINs for just those user entries without making changes to any of the other user entries. Instead of constructing a complex LDAP filter to filter out just these two entries, you can construct a general filter, put the two users' DNs in the input file, and run the PIN Generator.
- Assume that you want your users to use their social security numbers as PINs. You can enter users' social security numbers as PINs in the input file, and the PIN Generator will store them as hashed values in the directory.

The format of the input file is the same as that of the output file (see "Output File" on page 53), with the omission of the status line. In the input file, you can choose to specify PINs for all the DNs in the file, for specific DNs, or for none of the DNs. If the PIN attribute is missing for a DN, the tool automatically generates a random PIN.

For example, you can set up your input file to look like this:

```
dn:cn=user1, o=example.com
<blank line>

dn:cn=user2, o=example.com
<blank line>

...

dn:cn=user3, o=example.com
```

You can also provide PINs, in plain-text format, for the DNs in the input file, which is then hashed according to the command-line arguments. For example, you can set up your input file to look like this:

```
dn:cn=user1, o=example.com
pin:pl229Ab
<blank line>

dn:cn=user2, o=example.com
pin:9j65dSf
<blank line>

...
```

```
dn:cn=user3, o=example.com
pin:3knAg60
<blank line>
```

NOTE You cannot provide hashed PINs to the tool.

Output File

The PIN Generator can capture the output to a text file specified by the `output=<file_name>` argument.

The captured output will contain a sequence of records and will be in the following format:

```
dn: <user_dn>1
pin: <generated_pin>1
status: <status>1
<blank line>

dn: <user_dn>2
pin: <generated_pin>2
status: <status>2
<blank line>

...

dn: <user_dn>n
pin: <generated_pin>n
status: <status>n
<blank line>
```

where

`<user_dn>` is a distinguished name that matched the specified DN pattern (specified by the DN filter) or that was in the input file (the DN file). By default, the delimiter is "`;`" or the character defined on the command line.

`<generated_pin>` is a string of characters with either fixed or variable length, dependent on parameters passed into the command.

`<status>` is one of the values specified in Table 5-2 on page 51.

The first line in each record will always be the distinguished name. The subsequent lines, for `pin` and `status`, are optional. The record ends with a blank line. The end of line (EOL) sequence is as follows:

- On Unix: `\n`
- On Windows NT: `\r\n`

How PINs Are Stored in the Directory

Each PIN is concatenated with the corresponding user's LDAP attribute named in the `saltattribute` argument. If this argument is not specified, the DN of the user is used. Then, this string is hashed with the hash routine specified in the hash argument (the default selection is SHA-1).

Then, one byte is prepended to indicate the hash type used. Here’s how the PIN gets stored:

```
byte[0] = X
```

The value of `X` depends on the hash algorithm chosen during the PIN generation process:

`X=0` if the hash algorithm chosen is `SHA-1`.
`X=1` if the hash algorithm chosen is `MD5`.
`X=45` if the hash algorithm chosen is none.

```
byte[1...] = hash("DN"+"pin")
```

The PIN is stored in the directory as a binary value, not as a base-64 encoded value.

Exit Codes

The PIN Generator returns exit codes to the shell window; for a list of codes, see Table 5-3. If you plan on automating the PIN-generation process, exit codes are useful in programming shell scripts.

Table 5-3 Exit codes returned by the PIN Generator

Exit code	Description
`0`	Indicates that PIN generation was successful; that is, PINs are set for all the DNs in the specified directory.
`2`	Indicates that the tool could not open the certificate database specified by the `certdb` parameter.
`3`	Indicates that the tool could not locate the certificate specified by the `nickname` parameter in the specified certificate database.

Table 5-3 Exit codes returned by the PIN Generator *(Continued)*

Exit code	Description
4	Indicates that the tool could not bind to the directory as the user specified by the `binddn` parameter (over SSL).
5	Indicates that the tool could not open the output file specified by the `output` parameter.
7	Indicates an error parsing command-line arguments.
8	Indicates that the tool could not open the input file specified by the `input` parameter.
9	Indicates that the tool encountered an internal error.
10	Indicates that the tool found a duplicate entry in the input file specified by the `input` parameter.
11	Indicates that the tool didn't find the salt attribute, specified by the `saltattribute` parameter, in the directory.

Chapter 6

Extension Joiner Tool

Netscape Certificate Management System (CMS) provides many policy plug-in modules that enable you to add standard and custom X.509 certificate extensions to end-entity certificates the server issues. Similarly, the wizard that helps you generate the certificates required by the Certificate Manager, Registration Manager, Data Recovery Manager, and Online Certificate Status Manager enables you to select extensions that you want to include in the certificates. Additionally, the wizard interface and the request-approval page of the Agent interface contains a text area, enabling you to paste any extension in its MIME-64 encoded format.

Certificate Management System also provides tools that generate MIME-64 encoded blobs for many standard extensions. You can use these tools for generating MIME-64 encoded blobs for any extensions that you may want to include in CA and other certificate requests. The tools are located with the rest of the command-line utilities in this directory: `<server_root>/bin/cert/tools`

The text field provided for pasting the extension in general accepts a single extension blob. If you want to add multiple extensions, you should first join them to form a single extension blob and then paste the blob into the text field.

The ExtJoiner is a program that joins a sequence of extensions together so that the final output can be used in the wizard text field or in the request-approval page of the Agent interface for specifying multiple extensions.

This chapter has the following sections:

- “Location,” on page 58
- “Syntax,” on page 58
- “Usage,” on page 58

Location

The ExtJoiner program is located with the rest of the command-line tools in this directory: `<server_root>/bin/cert/tools`

Syntax

To run the `ExtJoiner` tool, type the following command:

```
java ExtJoiner <ext_file0> <ext_file1> ... <ext_fileN>
```

where `<ext_file>` specifies the path, including the filename, to files that contain the base-64 encoded DER encoding of an X.509 extension.

Usage

As discussed in the introduction of this chapter, the ExtJoiner program doesn't generate an extension in its MIME-64 encoded format, it only joins the extensions that are in MIME-64 encoded format. The steps below outline how you can use the `ExtJoiner` to join multiple custom extensions and add the extensions to a certificate request.

1. Write the appropriate Java programs for the extensions.
2. Join the extensions using ExtJoiner. To do this:
    a. Note the file paths to the files that contain the programs for extensions.
    b. Open a command window.
    c. Run the ExtJoiner, substituting the appropriate file paths. For example, if you have two extension files named `myExt1` and `myExt2` and have copied them to the same directory as the ExtJoiner, the command would look like this: `java ExtJoiner myExt1 myExt2`

       You should see a base-64 encoded blob, similar to the one below, of the joined extensions on screen:

       ```
       MEwwLgYDVR0lAQHBCQwIgYFKoNFBAMGClGC5EKDM5PeXzUGBi2CVyLNCQYFU
       iBakowGgYDVR0SBBMwEaQPMA0xCzAJBgNVBAYTAlVT
       ```
    d. Copy the encoded blob, without any modifications, to a file.

3. Verify that the extensions are joined correctly before adding them to a certificate request. To do this, first you'll need to convert the binary data to ASCII format using the `AtoB` utility and then verify the binary data by dumping the contents of the base-64 encoded blob using the `dumpasn1` utility. For information on the `AtoB` utility see, Chapter 8, "ASCII to Binary Tool" and for the `dumpasn1` utility see, Table 1-1 on page 13.

Here's how you would do this verification:

a. Go to this directory: `<server_root>/bin/cert/tools`

b. Enter this command: `AtoB <input_file> <output_file>`, substituting `<input_file>` with the path to the file that contains the base-64 encoded data in ASCII format (from Step 2) and `<output_file>` with the path to the file to write the base-64 encoded data in binary format.

c. Next, enter this command: `dumpasn1 <ouput_file>`, substituting `<output_file>` with the path to the file to that contains the base-64 encoded data in binary format. Your output should look similar to this:

```
0 30   76: SEQUENCE {
2 30   46:   SEQUENCE {
4 06    3:     OBJECT IDENTIFIER extKeyUsage (2 5 29 37)
9 01    1:     BOOLEAN TRUE
12 04   36:     OCTET STRING
           :       30 22 06 05 2A 83 45 04 03 06 0A 51 82 E4 42 83
           :       33 93 DE 5F 35 06 06 2D 82 57 22 CD 09 06 05 51
           :       38 81 6A 4A
           :     }
50 30   26:   SEQUENCE {
52 06    3:     OBJECT IDENTIFIER issuerAltName (2 5 29 18)
57 04   19:     OCTET STRING
           :       30 11 A4 0F 30 0D 31 0B 30 09 06 03 55 04 06 13
           :       02 55 53
           :     }
           :   }


      0 warnings, 0 errors.
```

d. If the output doesn't appear right, repeat steps 1 through 3 to get the correct output.

4. Copy the base-64 encoded blob in step 2 (the output generated by the ExtJoiner) to the CMS wizard screen and generate the certificate or the certificate signing request (CSR), if submitting the request to another CA.

Chapter 7

Backing Up and Restoring Data

This chapter explains how to back up the Netscape Certificate Management System (CMS) data and configuration information and how to use the backups to restore data if there is a need.

The chapter has the following sections:

- Backup and Restore Tools
- Backing Up Data
- Signing Backup Data Using cmsutil
- Verifying Signed Backup Data using cmsutil
- Restoring Data

Backup and Restore Tools

Certificate Management System provides tools to backup and restore the data and configuration for a CMS instance. These tools can be used, for example, to back up just your CMS data before you upgrade hardware or software on a machine. You might also use these tools as part of your overall system backup plan, perhaps to provide more frequent checkpoints of the CMS data than a nightly disk backup would record.

Since only CMS configuration and data are backed up, you will need to take other measures to back up data for external PKCS#11 cryptographic or key storage devices (such as smart card readers). If you rely on an external device for key storage (for example, to store the CA signing key), make sure that its data is backed up whenever you back up CMS data. When you restore the CMS data, it will rely on the external keys still being available. Refer to the PKCS#11 module vendor's instructions for how to back up the data.

The backup and restore tools are simple Perl scripts; most Perl programmers should find no difficulty in customizing or extending them. Read this chapter to familiarize yourself with how the scripts work as well as their capabilities and limitations.

The Perl scripts that perform the backup or restore are called from shell scripts installed in the `<server_root>/cert-<instance_id>/` directory of every CMS instance:

- `cmsbackup[.bat]` copies all of the pertinent data and configuration files for a CMS instance, the local Administration Server, and local Netscape Directory Servers that the instance uses into an compressed archive (a zip file). See "Backing Up Data" on page 62 for instructions on how to use this tool.
- `cmsrestore[.bat]` opens a named archive, extracts the data, and uses it to restore the configuration of a CMS instance. You have the option to restore everything or to select a subset of the archived data. See "Restoring Data" on page 70 for instructions on how to use this tool.

Be aware that the backup archives contain sensitive information (for example, your CMS key database). Protect the backup archives as carefully as you protect the server itself. The backups are stored on a local disk by default. To avoid losing both the current data and the backup because of a disk failure, move the backup archives to another medium as soon as they are created. If possible, encrypt the archives or store them on removable media in a secured location.

CMS backup data files can be optionally signed (and verified) from the command-line utilizing a separate tool called `<server_root>/bin/cert/tools/cmsutil`. For an example of signing backup data utilizing this tool, see "Signing Backup Data Using cmsutil," on page 67. For an example of verifying signed backup data utilizing this tool, see "Verifying Signed Backup Data using cmsutil," on page 69.

Optionally, CMS backup data files can be manually encrypted using some operating system specific utility; encrypted files must be manually decrypted using the same operating system specific utility prior to attempting data recovery

Backing Up Data

Backing up your data is actually a very simple process. You run the script, and it creates an archive that you store securely. This section explains what the backup tool (`cmsbackup`) does and does not do so that you can plan your overall system maintenance and backup procedures.

What the Backup Tool Does

There is a script or batch file installed in the instance directory of every CMS instance. This file calls the Perl script `<server_root>/bin/cert/tools/CMSBackup.pl` (using a Perl 5.005 interpreter bundled with Certificate Management System). `CMSBackup.pl` does the following:

- Creates a log file where all backup actions are logged
- Creates a temporary backup directory
- Copies CMS and non-CMS certificate and key databases and shared files
- Copies files required to configure the Netscape Console and Administration Server
- Backs up the configuration Directory Server using that server's `db2bak` backup utility (if the server is running locally)
- Backs up the CMS internal database (Directory Server) using that server's `db2bak` backup utility
- Copies CMS global and local class files
- Copies CMS user interface files and templates
- Copies CMS instance configuration files
- Creates a compressed archive of all files in the backup directory

The log file is in `<server_root>/cert-<instance_id>/logs/cmsbackup.log`. You should review the log file after each backup to make sure that all phases of the backup completed successfully. If all or part of the backup fails it is usually due to a directory that is missing or not readable by the user running the backup.

The default temporary backup directory is `/var/tmp` (Unix) or `C:\Temp` (Windows NT). Ensure that access to this directory is restricted so that no one can intercept backup files while the archive is being built. You can change the working backup directory by changing the value of `$backup_path_prefix` in `CMSBackup.pl`.

The CMS database, non-CMS databases and shared files that are backed up are:

- `<server_root>/alias/*`
- `<server_root>/shared/config/*.conf`

The Administration Server files that are backed up are the following files from `<server_root>/admin-serv/config/`:

- `admpw`, the Administration Server password cache

- `*.conf`, the Configuration files for the server and its associated LDAP data

The backup tool will use the Netscape Directory Server `db2bak` tool to create a backup of the CMS server instance internal database directory and the configuration directory (if it is running locally). Check the Netscape Directory Server documentation for full details on what this tool does. The data backed up includes all schema and object class definitions and, of course, all entries in the directory.

These CMS global and local class files are Java classes for custom plug-ins used by CMS servers. To back up this data, all files and subdirectories in the following directories are backed up:

- `<server_root>/bin/cert/classes`
- `<server_root>/cert-<instance_id>/classes`

The following CMS global configuration files, which are used for access control and the certificate mapping, are also backed up:

- `<server_root>/adminacl`
- `<server_root>/httpacl`
- `<server_root>/userdb`

The CMS user interface files and templates are the files used to create the forms end entities and agents use to interact with CMS servers. All of these files for the instance you are backing up are in

- `<server_root>/cert-<instance_id>/web-apps`
- `<server_root>/cert-<instance_id>/emails`

The CMS configuration files that get backed up are in `<server_root>/cert-<instance_id>/config`. The specific files and their purposes are:

- `CMS.cfg`, the current master configuration file for the instance.
- `CMS.cfg.*`, previous configuration files, available for reverting to an earlier configuration.
- `*.ldif`, ldif-format files that describe objects in the configuration database.
- `pwcache.db`, the server instance password cache.

All of the data to be backed up is copied to the temporary backup directory. After all of the data has been copied, the script archives the entire backup directory into a compressed archive using `zip` (a copy of `zip` is installed in `<server_root>/bin/cert/tools/zip`). The script deletes the backup directory once the zip archive is created.

What the Backup Tool Does Not Do

The `cmsbackup` script backs up only configuration and data related to a single CMS server instance. You may need to back up other files to recover from a failure completely, depending on the nature of the failure. For example, if some entries in your configuration Directory Server become corrupted then the data backed up by `cmsbackup` is sufficient to restore the directory to a previous state. If, however, you suffer a catastrophic disk failure, you will probably have to reinstall or restore Certificate Management System, Netscape Console, and Netscape Directory Server binaries and related tools before you use `cmsrestore` to recover your previous configuration.

The following is a list of items which may be part of your overall CMS deployment, but which are not backed up by `cmsbackup`:

- Other instances of CMS servers in the same server root

  Each instance has a copy of the cmsbackup script that backs up only data related to that instance.

- External PKCS#11 module data

  If you use an external PKCS#11 device for key storage, make sure you follow the vendor's instructions for backing up its data whenever you back up your CMS server. It may be possible to extend the `CMSBackup.pl` and `CMSRestore.pl` Perl scripts to include this data in the archives used by the CMS backup tools.

- Server binaries, libraries, and tools

  These files do not change after installation, and are not backed up. To restore these files, you can install the software again from the original media. You can also use a more generic disk backup tool to archive the contents of all directories beneath the server root.

Running the Backup Tool

Before you run `cmsbackup`, make sure that

- You are logged in as a user with permission to run `cmsbackup`, to run `db2bak` for the LDAP servers, and to write to the output directory; you may need to become superuser on a UNIX system or Administrator on a Windows NT system.
- There is plenty of disk space in the output directory; the size of the backup archive will vary with the amount of data in your system, so you will learn from experience how much space you require.

The configuration that you back up, of course, will use all of your current passwords. You will need to remember the current passwords if you restore this data after you change some passwords.

To run `cmsbackup`:

1. Log in to the machine where your CMS instance is running and open a command shell.
2. Change to the CMS server instance directory in the server root. For example, if your server root is `/usr/netscape/servers` and the instance ID of the server you want to back up is `cmsinstance`:

   ```
   # cd /usr/netscape/servers/cert-cmsinstance
   ```
3. Execute the backup script: either `cmsbackup` on UNIX or `cmsbackup.bat` on Windows NT systems. For example,

   ```
   # ./cmsbackup
   ```

The script will run. Control returns to the command prompt when the script has finished.

After You Finish a Backup

Immediately after running the backup tool, you should check the log file to make sure that all systems were archived successfully. The log file is

```
<server_root>/cert-<instance>/logs/cmsbackup.log
```

If the any part of the backup was not successful, there will be a message labeled `WARNING` or `ERROR` that tells you why. Most of the time, the problems are the result of directories or files that are missing or inaccessible to the user running `cmsbackup`. If necessary, change the permissions on the required files, delete the zip archive in the output directory, and run `cmsbackup` again.

Once you have a successful zip archive, you should secure it. The output directory is probably accessible to any user on the system, and it may be on the same physical disk as the server instance itself. You want to make sure the archive is not accessible to unauthorized users and that you can use the archive if there is a system hardware failure. Remember, the archive contains a database of private keys. Although it is not easy to extract a key from the database without the correct passwords, you do not want anyone to have the opportunity to try.

Move the zip archive to another machine or removable medium. If possible, encrypt the archive (do not use the private keys stored in your CMS server's database, since they may not be available when you need to restore the data). If you copy the archive to removable media such as tape or CD, make sure the copy is kept in a limited-access, locked area.

CMS backup data files can be optionally signed (and verified) from the command-line utilizing a separate tool called `<server_root>/bin/cert/tools/cmsutil`. For an example of signing backup data utilizing this tool, see "Signing Backup Data Using cmsutil," on page 67. For an example of verifying signed backup data utilizing this tool, see "Verifying Signed Backup Data using cmsutil," on page 69.

Optionally, CMS backup data files can be manually encrypted using some operating system specific utility; encrypted files must be manually decrypted using the same operating system specific utility prior to attempting data recovery

Signing Backup Data Using cmsutil

The following provides an example of using the tool called `<server_root>/bin/cert/tools/cmsutil` to sign backup data for a specific CMS subsystem instance on a UNIX system:

1. Generating an EMAIL Signing User Certificate:
   - Using the browser, issue a request for a user certificate.
   - Using the browser, approve the request for this user certificate.
   - Import this user certificate into the browser.
   - Export this user certificate out of the browser into a Public Key Cryptography Standard (PKCS) #12 file.
   - Move this file to the `<server_root>/alias` directory.
2. Sign the Backup Data

- Invoke a command-line interface such as a telnet session.
- From the command line, assuming a Bourne Shell ("sh") on a Solaris system, set and export the LD_LIBRARY_PATH environment variable:

  ```
  LD_LIBRARY_PATH=<server_root>/bin/cert/lib:$LD_LIBRARY_PATH
  export LD_LIBRARY_PATH
  ```
- From the command line, assuming a Bourne Shell ("sh") on a Solaris system, set and export the PATH environment variable:

  ```
  PATH=<server_root>/bin/cert/tools:$PATH
  export PATH
  ```
- Execute the following command:

  ```
  cd <server_root>/alias
  ```
- Execute the following command:

  ```
  ln -s <server_root>/alias/cert-<instance>-<hostname>-cert8.db
  cert8.db
  ```
- Execute the following command:

  ```
  ln -s <server_root>/alias/cert-<instance>-<hostname>-key3.db
  key3.db
  ```
- Import the EMAIL Signing user certificate and corresponding key from the PKCS #12 file specified in step 1 above into this `cert8.db` and `key3.db` respectfully by executing the following command:

  ```
  pk12util -i <PKCS #12 file> -d .
  ```
- Execute the following command:

  ```
  cd /var/tmp
  ```
- Execute the following command:

  `certutil -d <server_root>alias -L` to obtain the nickname of the EMAIL Signing user certificate

- Sign the CMS backup data file by executing the following command:

  ```
  cmsutil -S -N <nickname of EMAIL Signing user certificate> -T
  -i /var/tmp/<CMS backup data file> -o /var/tmp/<CMS backup
  data file signature file> -d <server_root>/alias -p
  <password>
  ```

  where the CMS backup data file signature file is of the form `CMS_<instance_name_minus_cert-_prefix>_BACKUP-<YYYYMMDDhhmmss>.signature`

Verifying Signed Backup Data using cmsutil

The following provides an example of using the tool called `<server_root>/bin/cert/tools/cmsutil` to verify signed backup data for a specific CMS subsystem instance on a UNIX system:

1. Verify the Backup Data File Signature

   - Invoke a command-line interface such as a telnet session
   - From the command line, assuming a Bourne Shell ("sh") on a Solaris system, set and export the LD_LIBRARY_PATH environment variable:

     ```
     LD_LIBRARY_PATH=<server_root>/bin/cert/lib:$LD_LIBRARY_PATH
     ```

     ```
     export LD_LIBRARY_PATH
     ```

   - From the command line, assuming a Bourne Shell ("sh") on a Solaris system, set and export the PATH environment variable:

     ```
     PATH=<server_root>/bin/cert/tools:$PATH
     ```

     ```
     export PATH
     ```

   - Execute the following command:

     ```
     cd <server_root>/alias
     ```

   - Execute the following command:

     ```
     ln -s <server_root>/alias/cert-<instance>-<hostname>-cert8.db
     cert8.db
     ```

   - Execute the following command:

     ```
     ln -s <server_root>/alias/cert-<instance>-<hostname>-key3.db
     key3.db
     ```

- Import the EMAIL Signing user certificate and corresponding key from the PKCS #12 file specified in “Signing Backup Data Using cmsutil,” on page 67 into this `cert8.db` and `key3.db` respectfully by executing the following command:

  ```
  pk12util -i <PKCS #12 file> -d .
  ```

- Execute the following command:

  ```
  cd /var/tmp
  ```

- Execute the following command:

  `certutil -d <server_root>alias -L` to obtain the nickname of the EMAIL Signing user certificate

- Verify the CMS backup data file signature by executing the following command:

  ```
  cmsutil -D -c /var/tmp/<CMS backup data file> -n -h 1 -i
  /var/tmp/<CMS backup data file signature file> -d
  <server_root>/alias
  ```

  where the CMS backup data file signature file is of the form `CMS_<instance_name_minus_cert-_prefix>_BACKUP-<YYYYMMDDhhmmss>.signature`

Restoring Data

The purpose of creating back up archives, of course, is to allow you to restore a previous state of the CMS server instance after a hardware or software failure corrupts your current state. The restore tool allows you to recover all or part of the configuration that was backed up. For example, you can use the tool to restore just the internal database of a CMS server instance.

A special case, automatic restore, allows you to completely restore the configuration from the latest backup archive quickly and without interaction.

Before You Restore Data

Before you can restore from a backup archive, the archive you want to use has to be available on a disk accessible from the server instance directory. If you want to use the automatic restore feature, you should put the archive in the output directory where `cmsbackup` originally created it (`C:\Temp` on Windows NT or `/var/tmp` on UNIX).

Note the full path name to the backup archive; in the instructions later it will be referred to as `<archive_path>`. For example, on a UNIX system, the `<archive_path>` might be

`/var/tmp/CMS_cmsdemo_BACKUP-19991115093827.zip`.

CMS backup data files can be optionally signed (and verified) from the command-line utilizing a separate tool called `<server_root>/bin/cert/tools/cmsutil`. If the file was signed, you might want to use this utility to verify. For an example of signing backup data utilizing this tool, see "Signing Backup Data Using cmsutil," on page 67. For an example of verifying signed backup data utilizing this tool, see "Verifying Signed Backup Data using cmsutil," on page 69.

You can use the word `automatic` instead of a path name to indicate the location of the backup archive. If you use `automatic`, the restore tool will read the file `logs/latest_backup` to find the path name of the archive. This file is created by `cmsbackup` and contains the name of the last archive created. Note that `automatic` always causes *all* data to be restored: you will not be able to select only a subset of the data.

If you moved the zip archive to another machine or removable medium, copy it back to the local file system. If you encrypted the archive, decrypt it before you try to restore the data.

You cannot restore data to a CMS instance that has not been configured. If you re-installed CMS prior to attempting to restore data, you must configure the new CMS instance. When you configure the new installation, keep the following points in mind:

- All services should be running on the same network ports as they were when the backup archive was created. For example, the administration console port is a random number by default; be sure to change the default to the same port that your original installation used.

- During configuration, you still need to create new keys and certificates for any servers that use the internal token. You only need to create these keys to complete the configuration process. Your signing, SSL, or DRM transport certificates will be restored (replacing whatever you create during the new configuration) when you run the restore script.

The user running the restore tool will probably need superuser (UNIX) or Administrator (Windows NT) privileges. The user running the tool will need privileges to do the following:

- Read the backup zip archive
- Create a temporary working directory in the directory where the archive is located
- Create directories and files in the server root and server instance directories (for example, if the `CMS.cfg` file needs to be restored)
- Run the `bak2db` tool for any Netscape Directory Servers that are being restored
- (UNIX) Change file ownership of the LDAP database backup files to the Directory Server user. The Directory Server user is defined by the `localuser` parameter in `slapd.conf`. If the Directory Server user is different from the user running `cmsrestore`, the user running the tool must be able to run `chown` to change the owner of the files to the LDAP server user (typically only the superuser has this privilege).

The process of restoring data will require that some servers be stopped and restarted. If any of your servers require passwords to start (for example, if they need to unlock the key database in order to listen for SSL requests), you will be prompted for the password. If any passwords have changed since you created the backup archive, make sure you know the password that was valid at the time the archive was created.

Running the Restore Tool

To run `cmsrestore`:

1. Log in to the machine where the CMS instance you want to restore is installed and open a command shell.
2. Change to the CMS server instance directory in the server root. For example, if your server root is `/usr/netscape/servers` and the instance ID of the server you want to restore is `cmsinstance`:

```
# cd /usr/netscape/servers/cert-cmsinstance
```

3. Execute the restore script: either `cmsrestore` on UNIX or `cmsrestore.bat` on Windows NT systems.

   You can either provide the `<archive_path>` as an argument or use the argument `automatic` (to read the archive path from `logs/latest_backup`):

   ```
   # ./cmsrestore <archive_path> | automatic
   ```

   For example,

   ```
   # ./cmsrestore \
   /var/tmp/CMS_cmsdemo_BACKUP-19991115093827.zip
   ```

   If you use `automatic` as the argument, the restore proceeds automatically; go to Step 9 when `cmsrestore` completes.

4. The script asks if you would like to perform a complete or prompted restore. Enter

   - `c` (complete) to completely restore the contents of the archive without further prompts. Proceed with Step 9 when the restore is complete.
   - `p` (prompted) to have the script ask you whether you want to restore specific parts of the archive.

5. If the configuration Directory Server is located in the same server root, the first prompt asks if you want to restore it. The configuration Directory Server is the directory used by the Administration Server to store information about servers, users, and groups.

   If you answer `yes`, the restore tool stops the Directory Server, restores the data, then restarts the server. You may be asked to enter a password if one is required to start the server.

6. Next you are asked if you want to restore selected Administration Server data.

   If you answer `no`, no Administration Server data will be restored; proceed with the next step.

   If you answer `yes`, you will be asked six more questions about specific Administration Server data you want to restore:

   a. Main admin data is data in the Administration Server’s configuration directory.

   b. Non-CMS HTTP ACLs.

   c. Non-CMS admin ACLs.

   d. Non-CMS user database.

  e. Non-CMS shared data is data in the `<server_root>/shared/config` directory.

  f. CMS certificate and key databases are the databases in the `<server_root>/alias` directory.

  After you answer the questions, the Administration Server is stopped, the data restored from the archive, and the server is started again. If necessary, you will be prompted to enter a password to start the Administration Server.

7. Next you are asked if you want to restore the CMS internal database Directory Server. This is the Directory Server this CMS instance uses as its internal database.

   If you answer `yes`, the restore tool stops the Directory Server, restores the data, then restarts the server. You may be asked to enter a password if one is required to start the server.

8. Next you are asked if you want to restore selected data for this CMS server instance.

   If you answer `yes`, you will be asked five more questions about the following CMS server instance data that you can restore:

   a. Global CMS classes are Java classes that are shared by all CMS servers in the same server root.

   b. Critical CMS data includes the configuration files, and password cache in the `config` directory for this CMS instance.

   c. Local CMS emails.

   d. Local CMS classes are Java classes used only by this server instance.

   e. Custom CMS UI data includes all HTML files and templates in the `web-apps` and `emails` directory of this CMS instance.

   After you answer these questions, the tool stops the CMS server, restores the data, then restarts the server. You will be asked to enter the single sign-on password that unlocks the password cache when the server restarts (usee section “Password Cache” in Chapter 7, “Administrative Basics” of *CMS Administrator’s Guide*.)

9. After the tool finishes restoring data, view the `cmsrestore.log` file in the server instance `logs` directory.

Review each step to make sure there were no errors in restoring the data. If there were errors or warnings, you may want to run `cmsrestore` again. You may need to change permissions on some files or manually start some servers before running `cmsrestore` again.

The restore tool deletes the working directory where it unpacked the archive, but it does not delete the archive itself. You probably will not want to keep the backup archive on disk. Remember that the backup archive contains sensitive information. Delete or secure the archive when you are done using it to restore data.

ASCII to Binary Tool

You can use the ASCII to Binary tool to convert ASCII base-64 encoded data to binary base-64 encoded data.

This chapter has the following sections:

- “Location,” on page 77
- “Syntax,” on page 77
- “Example,” on page 78

Location

The tool is located with the rest of the command-line tools in this directory: `<server_root>/bin/cert/tools`

Syntax

To run the ASCII to Binary tool, type the following command:

```
AtoB[.bat] <input_file> <output_file>
```

`.bat` specifies the file extension; this is required only when running the utility on a Windows NT system.

`<input_file>` specifies the path to the file that contains the base-64 encoded data in ASCII format.

`<output_file>` specifies the path to the file to write the base-64 encoded data in binary format.

Example

```
AtoB.bat C:\test\data.in C:\test\data.out
```

The above command takes the base-64 encoded data (in ASCII format) in the file named `data.in` and writes the binary equivalent of the data to the file named `data.out`.

Chapter 9

Binary to ASCII Tool

You can use the Binary to ASCII tool to convert binary base-64 encoded data to ASCII base-64 encoded data.

The chapter has the following sections:

- "Location," on page 79
- "Syntax," on page 79
- "Example," on page 80

Location

The tool is located with the rest of the command-line tools in this directory:
`<server_root>/bin/cert/tools`

Syntax

To run the Binary to ASCII tool, type the following command:

```
BtoA[.bat] <input-file> <output_file>
```

`.bat` specifies the file extension; this is required only when running the utility on a Windows NT system.

`<input_file>` specifies the path to the file that contains the base-64 encoded data in binary format.

`<output_file>` specifies the path to the file to write the base-64 encoded data in ASCII format.

Example

```
BtoA.bat C:\test\data.in C:\test\data.out
```

The above command takes the base-64 encoded data (in binary format) in the file named `data.in` and writes the ASCII equivalent of the data to the file named `data.out`.

Chapter 10

Pretty Print Certificate Tool

You can use the Pretty Print Certificate tool to print the contents of a certificate stored as ASCII base-64 encoded data in a human-readable form.

The chapter has the following sections:

- "Location," on page 81
- "Syntax," on page 81
- "Examples," on page 82

Location

The tool is located with the rest of the command-line tools in this directory:
`<server_root>/bin/cert/tools`

Syntax

To run the Pretty Print Certificate tool, type the following command:

```
PrettyPrintCert[.bat] [options] <input_file> [<output_file>]
```

`.bat` specifies the file extension; this is required only when running the utility on a Windows NT system.

`[options]` consists of "-simpleinfo," which prints limited certificate information in an easy to parse format.

`<input_file>` specifies the path to the file that contains the ASCII base-64 encoded certificate.

`<output_file>` specifies the path to the file to write the certificate. This argument is optional; if you don't specify an output file, the certificate information is written to the standard output.

Examples

```
PrettyPrintCert.bat C:\test\cert.in C:\test\cert.out
```

The above command takes the ASCII base-64 encoded certificate in the `cert.in` file and writes the certificate in the pretty-print form to the output file named `cert.out`.

The base-64 encoded certificate (content of the `cert.in` file) would look similar to this:

```
-----BEGIN CERTIFICATE-----
MIIC2DCCAkGgAwIBAgICEAwwDQYJKoZIhvcNAQEFBQAwfDELMAkGA1UEBhMCVVMxIzA
hBgNVBAoTGlBhbG9va2FWaWxsZSBXaWRnZXRzLCBJbmMuMR0wGwYDVQQLExRXaWRnZX
QgTWFrZXJzICdSJyBVczEpMCcGA1UEAxMgVGVzdCBUZXN0IFRlc3QgVGVzdCBUZXN0I
FRlc3QgQ0EwHhcNOTkwMjE4MDMMzM5WhcNMDAwMjE4MDM0MzM5WjCBrjELMAkGA1UEB
hMCVVMxJjAkBgNVBAoTHU5ldHNjYXBlIENvbW11bmljYXRpb25zIENvcnAuMRUwEwYD
VQQLEwOZXRzY2FwZSBDTVMxGDAWBEBEwhtaGFybXNlbjEfMB0GA1UEAxWaW50ZGV2Y2
EgQWRtaW5pcwp0frfJOObeiSsia3BuifRHBNw95ZZQR9NIXr1x5bE
-----END CERTIFICATE-----
```

The certificate in pretty-print form (content of the `cert.out` file) would look similar to this:

```
Certificate:

    Data:

        Version:  v3

        Serial Number: 0x100C

        Signature Algorithm: OID.1.2.840.113549.1.1.5 -1.2.840.113549.1.1.5

        Issuer: CN=Test CA,OU=Widget Makers 'R'Us,O=Example Corporation,
                Widgets\,Inc.,C=US

        Validity:
              Not Before: Wednesday, February 17, 1999 7:43:39 PM
              Not  After: Thursday, February 17, 2000 7:43:39 PM

        Subject: MAIL=admin@example.com,CN=testCA Administrator, UID=admin,
                OU=IS, O=Example Corporation,C=US
```

```
Subject Public Key Info:
     Algorithm: RSA - 1.2.840.113549.1.1.1
     Public Key:
       30:81:89:02:81:81:00:DE:26:B3:C2:9D:3F:7F:FA:DF:
       24:E3:9B:7A:24:AC:89:AD:C1:BA:27:D1:1C:13:70:F7:
       96:59:41:1F:4D:21:7A:F5:C7:96:C4:75:83:35:9F:49:
       E4:B0:A7:5F:95:C4:09:EA:67:00:EF:BD:7C:39:92:11:
       31:F2:CA:C9:16:87:B9:AD:B8:39:69:18:CE:29:81:5F:
       F3:4D:97:B9:DF:B7:60:B3:00:03:16:8E:C1:F8:17:6E:
       7A:D2:00:0F:7D:9B:A2:69:35:18:70:1C:7C:AE:12:2F:
       0B:0F:EC:69:CD:57:6F:85:F3:3E:9D:43:64:EF:0D:5F:
       EF:40:FF:A6:68:FD:DD:02:03:01:00:01:

Extensions:
     Identifier: 2.16.840.1.113730.1.1
       Critical: no
       Value: 03:02:00:A0:

     Identifier: Authority Key Identifier - 2.5.29.35
       Critical: no
       Key Identifier:
           EB:B5:11:8F:00:9A:1A:A6:6E:52:94:A9:74:BC:65:CF:
           07:89:2A:23:

Signature:
     Algorithm: OID.1.2.840.113549.1.1.5 - 1.2.840.113549.1.1.5
     Signature:
       3E:8A:A9:9B:D1:71:EE:37:0D:1F:A0:C1:00:17:53:26:
       6F:EE:28:15:20:74:F6:C5:4F:B4:E7:95:3C:A2:6A:74:
       92:3C:07:A8:39:12:1B:7E:C4:C7:AE:79:C8:D8:FF:1F:
       D5:48:D8:2E:DD:87:88:69:D5:3A:06:CA:CA:9C:9A:55:
       DA:A9:E8:BF:36:BC:68:6D:1F:2B:1C:26:62:7C:75:27:
       E2:8D:24:4A:14:9C:92:C6:F0:7A:05:A1:52:D7:CC:7D:
       E0:9D:6C:D8:97:3A:9C:12:8C:25:48:7F:51:59:BE:3C:
       2B:30:BF:EB:0A:45:7D:A6:49:FB:E7:BE:04:05:D6:8F:
```

```
PrettyPrintCert.bat -simpleinfo C:\test\cert.in C:\test\cert.simple
```

The above command takes the ASCII base-64 encoded certificate in the cert.in file and writes simple information contained within the certificate to the output file named cert.simple.

The base-64 encoded certificate (content of the cert.in file) would look similar to this:

```
-----BEGIN CERTIFICATE-----
MIIC2DCCAkGgAwIBAgICEAwwDQYJKoZIhvcNAQEFBQAwfDELMAkGA1UEBhMCVVMxIzA
hBgNVBAoTGlBhbG9va2FWaWxsZSBXaWRnZXRzLCBJbmMuMR0wGwYDVQQLExRXaWRnZX
QgTWFrZXJzICdSJyBVczEpMCcGA1UEAxMgVGVzdCBUZXN0IFRlc3QgVGVzdCBUZXN0I
FRlc3QgQ0EwHhcNOTkwMjE4MDMMzM5WhcNMDAwMjE4MDM0MzM5WjCBrjELMAkGA1UEB
hMCVVMxJjAkBgNVBAoTHU5ldHNjYXBlIENvbW11bmljYXRpb25zIENvcnAuMRUwEwYD
VQQLEwOZXRzY2FwZSBDTVMxGDAWBEBEwhtaGFybXNlbjEfMB0GA1UEAxWaW50ZGV2Y2
EgQWRtaW5pcwp0frfJOObeiSsia3BuifRHBNw95ZZQR9NIXr1x5bE
-----END CERTIFICATE-----
```

The simple certificate information (content of the cert.simple file) would look similar to this:

```
MAIL=admin@example.com
CN=testCA Administrator
UID=admin
OU=IS
O=Example Corporation
C=US
```

Chapter 11

Pretty Print CRL Tool

You can use the Pretty Print CRL tool to print the contents of a CRL stored as ASCII base-64-encoded data in a human-readable form.

The chapter has the following sections:

- "Location," on page 85
- "Syntax," on page 85
- "Example," on page 86

Location

The tool is located with the rest of the command-line tools in this directory:
`<server_root>/bin/cert/tools`

Syntax

To run the Pretty Print CRL tool, type the following command:

```
PrettyPrintCrl[.bat] <input_file> [<output-file>]
```

`.bat` specifies the file extension; this is required only when running the utility on a Windows NT system.

`<input_file>` specifies the path to the file that contains the ASCII base-64 encoded CRL.

`<output_file>` specifies the path to the file to write the CRL. This argument is optional; if you don't specify an output file, the CRL information is written to the standard output.

Example

```
PrettyPrintCrl.bat C:\test\crl.in C:\test\crl.out
```

The above command takes the ASCII base-64 encoded CRL in the `crl.in` file and writes the CRL in the pretty-print form to the output file named `crl.out`.

The base-64 encoded CRL (content of the `crl.in` file) would look similar to this:

```
-----BEGIN CRL-----
MIIBkjCBAIBATANBgkqhkiG9w0BAQQFADAsMREwDwYDVQQKEwhOZXRzY2FwZTEXMBUG
A1UEAxMOQ2VydDQwIFRlc3QgQ0EXDTk4MTIxNzIyMzcyNFowgaowIAIBExcNOTgxMjE
1MTMxODMyWjAMMAoGA1UdFQQDCgEBMCACARIXDTk4MTINTEzMjA0MlowDDAKBgNVHRU
EAwoBAjAgAgERFw05ODEyMTYxMjUxNTRaMAwwCgYDVR0VBAMKAQEwIAIBEBcNOTgxMj
E3MTAzNzI0WjAMMAoGA1UdFQQDCgEDMCACAQoXDTk4MTEyNTEzMTExOFowDDAKBgNVH
RUEAwoBATANBgkqhkiG9w0BQQFAAOBgQBCN85O0GPTnHfImYPROvoorx7HyFz2ZsuKs
VblTcemsX0NL7DtOa+MyY0pPrkXgm157JrkxEJ7GBOeogbAS6iFbmeSqPHj8+
-----END CRL-----
```

The CRL in pretty-print form (content of the `crl.out` file) would look similar to this:

```
Certificate Revocation List:

   Data:

      Version:  v2

      Signature Algorithm: MD5withRSA - 1.2.840.113549.1.1.4

      Issuer: CN=Test CA,O=Example Corporation

      This Update: Thu Dec 17 14:37:24 PST 1998

      Revoked Certificates:

         Serial Number: 0x13
         Revocation Date: Tuesday, December 15, 1998 5:18:32 AM
         Extensions:
            Identifier: Revocation Reason - 2.5.29.21
            Critical: no
            Reason: Key_Compromise

         Serial Number: 0x12
         Revocation Date: Tuesday, December 15, 1998 5:20:42 AM
         Extensions:
            Identifier: Revocation Reason - 2.5.29.21
            Critical: no
            Reason: CA_Compromise
      Serial Number: 0x11
      Revocation Date: Wednesday, December 16, 1998 4:51:54 AM
      Extensions:
         Identifier: Revocation Reason - 2.5.29.21
         Critical: no
         Reason: Key_Compromise

      Serial Number: 0x10
      Revocation Date: Thursday, December 17, 1998 2:37:24 AM
      Extensions:
         Identifier: Revocation Reason - 2.5.29.21
         Critical: no
         Reason: Affiliation_Changed

      Serial Number: 0xA
      Revocation Date: Wednesday, November 25, 1998 5:11:18 AM
      Extensions:
         Identifier: Revocation Reason - 2.5.29.21
         Critical: no
         Reason: Key_Compromise

   Signature:
      Algorithm: MD5withRSA - 1.2.840.113549.1.1.4
      Signature:
         42:37:CE:4E:D0:63:D3:9C:77:C8:99:83:D1:3A:FA:28:
         AF:1E:C7:C8:5C:F6:66:CB:8A:B1:56:E5:4D:C7:A6:B1:
         7D:0D:2F:B0:ED:39:AF:8C:C9:8D:29:3E:B9:17:82:6D:
         79:EC:9A:E4:C4:42:7B:18:13:9E:A2:06:C0:4B:A8:85:
         6E:67:92:A8:F1:E3:F3:E2:41:1F:9B:2D:24:D9:DF:4C:
         2B:A1:68:CE:96:C7:AF:F7:5B:F7:3D:2F:06:57:39:74:
         CF:B2:FA:46:C6:AD:18:60:8D:3E:0C:F7:C1:66:52:37:
         CF:89:42:B0:D7:33:C4:95:7E:F4:D9:1E:32:B8:5E:12:
```

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